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PLUTONIUM RELEASE
BUILDING 3019, OAK RIDGE NATIONAL LABORATORY

by

L. J. King

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
Operated by
UNION CARBIDE CORPORATION
for the
U. S. ATOMIC ENERGY COMMISSION

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L. J. King* (ORNL)

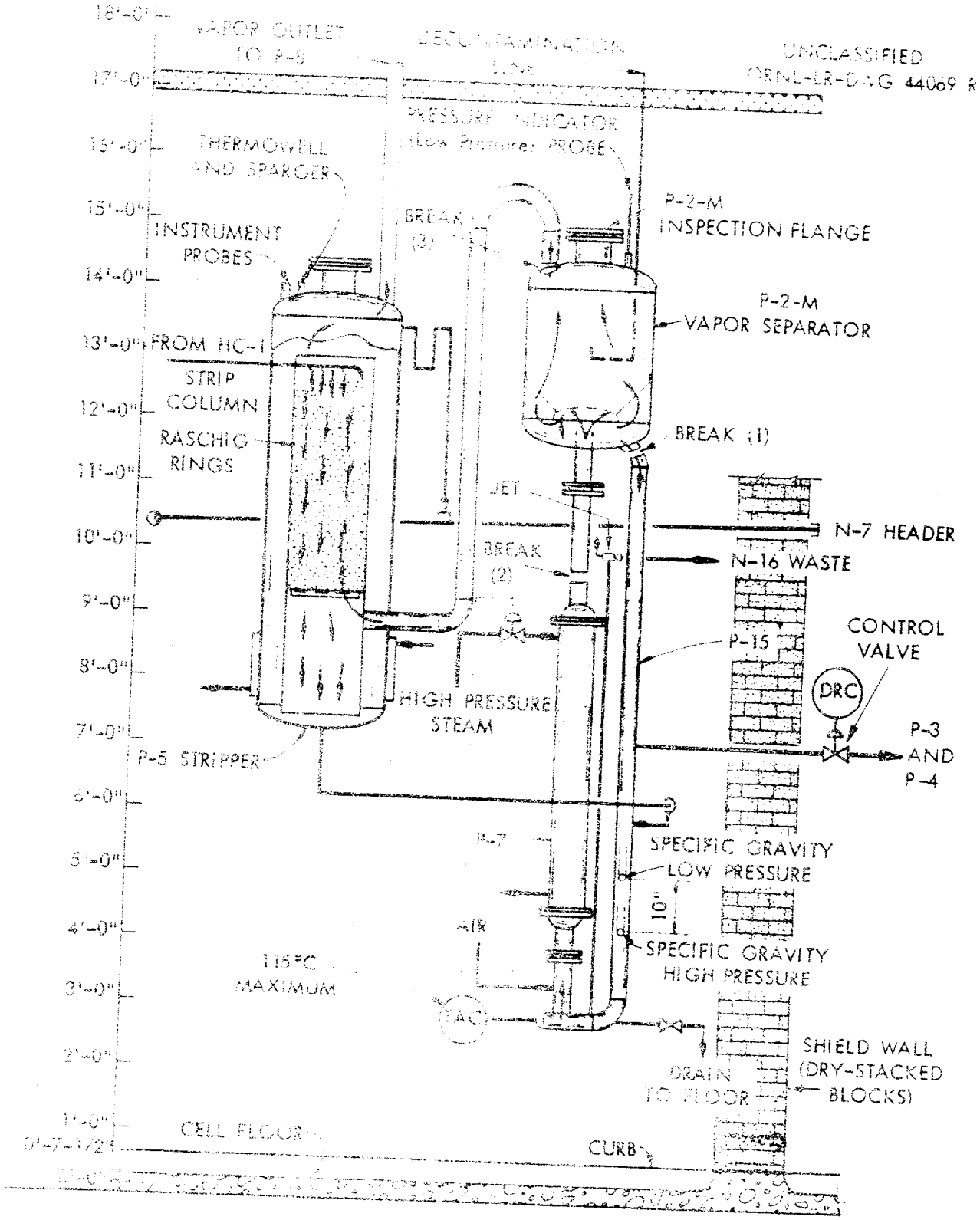
SUMMARY

A non-nuclear explosion involving an evaporator occurred in a shielded cell in the Radiochemical Processing Pilot Plant.[1] Of the approximate 15 g of plutonium released by the explosion about 600 mg escaped the cell and was deposited on nearby streets and building surfaces and about 70 mg contaminated the interior of the building housing the pilot plant. The remainder was contained by the cell. No personnel were injured by the explosion and no one received a significant fraction of a lifetime body burden of plutonium either at the time of the incident or during subsequent cleanup operations.

The explosion was due to the deflagration of nitrated organic compounds formed by the nitration of 14 liters of a proprietary decontaminating agent which is a strongly basic solution of the alkali salts of various organic hydroxy acids, various amines, surface active agents, and phenol.

The cell in which the explosion occurred is one of four cells containing equipment for solvent extraction processing of highly irradiated nuclear fuels. The evaporator, contained in a subcell which is walled off by concrete blocks within the cell, consisted of a steam stripper, vapor separator and connecting piping (Fig. 1). Uranium-plutonium-bearing aqueous solution flowed by gravity through the steam stripper, for removal of entrained and dissolved organic compounds, to the natural-convection evaporator loop.

*ANS member.


UNCLASSIFIED
ORNL-LR-DWG 44069 R
VAPOR OUTLET TO P-8
DECONTAMINATION LINE
PRESSURE INDICATOR
THERMOWELL AND SPARGER
INSTRUMENT PROBES
BREAK (3)
P-2-M INSPECTION FLANGE
P-2-M VAPOR SEPARATOR
FROM HC-1
STRIP COLUMN
RASCHIG RINGS
BREAK (1)
JET
N-7 HEADER
BREAK (2)
N-16 WASTE
CONTROL VALVE
P-15
DRC
HIGH PRESSURE STEAM
P-3 AND P-4
P-5 STRIPPER
SPECIFIC GRAVITY LOW PRESSURE
10"
AIR
115°C MAXIMUM
SPECIFIC GRAVITY HIGH PRESSURE
TAC
SHIELD WALL (DRY-STACKED BLOCKS)
DRAIN TO FLOOR
CELL FLOOR
CURB
18'-0"
17'-0"
16'-0"
15'-0"
14'-0"
13'-0"
12'-0"
11'-0"
10'-0"
9'-0"
8'-0"
7'-0"
6'-0"
5'-0"
4'-0"
3'-0"
2'-0"
1'-0"
0'-7-1/2"

Overhead vapor from the evaporator was routed from the vapor separator through the packed section of the steam stripper, where it served as the stripping medium, and then to the condensate collection system.

About one month preceding the incident, after several processing campaigns with highly irradiated uranium had been completed, a decontamination program was begun. One objective of this program was to decontaminate the evaporator subcell which was emanating greater than 100 r/hr of penetrating radiation.

After two series of decontamination treatments did not reduce the radiation level in the evaporator subcell, a proprietary decontaminating agent was added to the evaporator and boiled for 2 hr. The evaporator was drained through a remotely operated product outlet valve because the valve normally intended for draining was located in the 100 r/hr radiation zone; this left a heel containing 13.9 liters of the organic compounds. Next 270 liters of 4 M HNO_3 was added to the evaporator, omitting the normal water flush. The heat exchanger steam was turned on, providing sufficient heat to concentrate the nitric acid and allow complete reaction between the acid and organic compounds. As the acid became concentrated the temperature increased steadily until the nitro compounds, just formed, ignited and exploded.[2]

The pilot plant facility was not capable of containing the plutonium released from the evaporator by the explosion. The cell ventilation filters retained the alpha activity with a high degree of efficiency,[3] but the ease with which the cell door was blown open directly to outside ground level precluded confinement of plutonium to the building.

Since this incident all buildings at the Laboratory in which signifi-

cant quantities of radioactive materials are being handled or processed have been examined and evaluated for their ability to contain hazardous materials in the case of the maximum credible accident. The general philosophy and standards which have been adopted for containment or confinement of reactors have been applied to all radioactive operations at Oak Ridge National Laboratory.

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3. M. H. Lloyd, "Radioactivity Collected on Building 3019 Off-Gas Filters," ORNL-CF-60-8-38 (in preparation).

LJK:lj